



033267-021.ST25

SEQUENCE LISTING

<110> Schmaljohn, Connie S.
Fuller, James T.

<120> Nucleic Acid Immunization

<130> 033267-021

<140> US 10/411,205

<141> 2003-04-11

<160> 8

<170> FastSEQ for Windows Version 4.0

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<212> DNA

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<220>

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<212> DNA

<213> Artificial Sequence

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<223> synthetic oligonucleotides which comprise CpG
motifs

<400> 2

atcgactctc gagcgttctc

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<210> 3

<211> 2605

<212> DNA

<213> Bacillus anthracis

<220>

<221> CDS

<222> (174)...(2465)

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tttaaaaagc caaaaataaa taattatctc tttttattta tattatattg aaactaaagt 120
ttattaattt caatataata taaatttaat tttatacaaa aaggagaacg tat atg 176
Met
1

aaa aaa cga aaa gtg tta ata cca tta atg gca ttg tct acg ata tta 224
Lys Lys Arg Lys Val Leu Ile Pro Leu Met Ala Leu Ser Thr Ile Leu
5 10 15

| | |
|---|-----|
| gtt tca agc aca ggt aat tta gag gtg att cag gca gaa gtt aaa cag | 272 |
| Val Ser Ser Thr Gly Asn Leu Glu Val Ile Gln Ala Glu Val Lys Gln | |
| 20 25 30 | |
| gag aac cgg tta tta aat gaa tca gaa tca agt tcc cag ggg tta cta | 320 |
| Glu Asn Arg Leu Leu Asn Glu Ser Glu Ser Ser Ser Gln Gly Leu Leu | |
| 35 40 45 | |
| gga tac tat ttt agt gat ttg aat ttt caa gca ccc atg gtg gtt acc | 368 |
| Gly Tyr Tyr Phe Ser Asp Leu Asn Phe Gln Ala Pro Met Val Val Thr | |
| 50 55 60 65 | |
| tct tct act aca ggg gat tta tct att cct agt tct gag tta gaa aat | 416 |
| Ser Ser Thr Thr Gly Asp Leu Ser Ile Pro Ser Ser Glu Leu Glu Asn | |
| 70 75 80 | |
| att cca tcg gaa aac caa tat ttt caa tct gct att tgg tca gga ttt | 464 |
| Ile Pro Ser Glu Asn Gln Tyr Phe Gln Ser Ala Ile Trp Ser Gly Phe | |
| 85 90 95 | |
| atc aaa gtt aag aag agt gat gaa tat aca ttt gct act tcc gct gat | 512 |
| Ile Lys Val Lys Lys Ser Asp Glu Tyr Thr Phe Ala Thr Ser Ala Asp | |
| 100 105 110 | |
| aat cat gta aca atg tgg gta gat gac caa gaa gtg att aat aaa gct | 560 |
| Asn His Val Thr Met Trp Val Asp Asp Gln Glu Val Ile Asn Lys Ala | |
| 115 120 125 | |
| tct aat tct aac aaa atc aga tta gaa aaa gga aga tta tat caa ata | 608 |
| Ser Asn Ser Asn Lys Ile Arg Leu Glu Lys Gly Arg Leu Tyr Gln Ile | |
| 130 135 140 145 | |
| aaa att caa tat caa cga gaa aat cct act gaa aaa gga ttg gat ttc | 656 |
| Lys Ile Gln Tyr Gln Arg Glu Asn Pro Thr Glu Lys Gly Leu Asp Phe | |
| 150 155 160 | |
| aag ttg tac tgg acc gat tct caa aat aaa aaa gaa gtg att tct agt | 704 |
| Lys Leu Tyr Trp Thr Asp Ser Gln Asn Lys Lys Glu Val Ile Ser Ser | |
| 165 170 175 | |
| gat aac tta caa ttg cca gaa tta aaa caa aaa tct tcg aac tca aga | 752 |
| Asp Asn Leu Gln Leu Pro Glu Leu Lys Gln Lys Ser Ser Asn Ser Arg | |
| 180 185 190 | |
| aaa aag cga agt aca agt gct gga cct acg gtt cca gac cgt gac aat | 800 |
| Lys Lys Arg Ser Thr Ser Ala Gly Pro Thr Val Pro Asp Arg Asp Asn | |
| 195 200 205 | |
| gat gga atc cct gat tca tta gag gta gaa gga tat acg gtt gat gtc | 848 |
| Asp Gly Ile Pro Asp Ser Leu Glu Val Glu Gly Tyr Thr Val Asp Val | |
| 210 215 220 225 | |
| aaa aat aaa aga act ttt ctt tca cca tgg att tct aat att cat gaa | 896 |
| Lys Asn Lys Arg Thr Phe Leu Ser Pro Trp Ile Ser Asn Ile His Glu | |
| 230 235 240 | |
| aag aaa gga tta acc aaa tat aaa tca tct cct gaa aaa tgg agc acg | 944 |
| Lys Lys Gly Leu Thr Lys Tyr Lys Ser Ser Pro Glu Lys Trp Ser Thr | |

| | | | | | | | | | | | | | | | | | | |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|--|--|
| 245 | | | | | | 250 | | | | | | 255 | | | | | | |
| gct Ala | tct Ser | gat Asp 260 | ccg Pro | tac Tyr | agt Ser | gat Asp | ttc Phe 265 | gaa Glu | aag Lys | gtt Val | aca Thr | gga Gly 270 | cgg Arg | att Ile | gat Asp | 992 | | |
| aag Lys | aat Asn 275 | gta Val | tca Ser | cca Pro | gag Glu | gca Ala 280 | aga Arg | cac His | ccc Pro | ctt Leu | gtg Val 285 | gca Ala | gct Ala | tat Tyr | ccg Pro | 1040 | | |
| att Ile 290 | gta Val | cat His | gta Val | gat Asp | atg Met 295 | gag Glu | aat Asn | att Ile | att Ile | ctc Leu 300 | tca Ser | aaa Lys | aat Asn | gag Glu | gat Asp 305 | 1088 | | |
| caa Gln | tcc Ser | aca Thr | cag Gln | aat Asn 310 | act Thr | gat Asp | agt Ser | gaa Glu | acg Thr 315 | aga Arg | aca Thr | ata Ile | agt Ser | aaa Lys 320 | aat Asn | 1136 | | |
| act Thr | tct Ser | aca Thr | agt Ser 325 | agg Arg | aca Thr | cat His | act Thr | agt Ser 330 | gaa Glu | gta Val | cat His | gga Gly 335 | aat Asn | gca Ala | gaa Glu | 1184 | | |
| gtg Val | cat His | gcg Ala 340 | tcg Ser | ttc Phe | ttt Phe | gat Asp | att Ile 345 | ggt Gly | ggg Gly | agt Ser | gta Val | tct Ser 350 | gca Ala | gga Gly | ttt Phe | 1232 | | |
| agt Ser | aat Asn 355 | tcg Ser | aat Asn | tca Ser | agt Ser | acg Thr 360 | gtc Val | gca Ala | att Ile | gat Asp | cat His 365 | tca Ser | cta Leu | tct Ser | cta Leu | 1280 | | |
| gca Ala 370 | ggg Gly | gaa Glu | aga Arg | act Thr | tgg Trp 375 | gct Ala | gaa Glu | aca Thr | atg Met | ggt Gly 380 | tta Leu | aat Asn | acc Thr | gct Ala | gat Asp 385 | 1328 | | |
| aca Thr | gca Ala | aga Arg | tta Leu | aat Asn 390 | gcc Ala | aat Asn | att Ile | aga Arg | tat Tyr 395 | gta Val | aat Asn | act Thr | ggg Gly | acg Thr 400 | gct Ala | 1376 | | |
| cca Pro | atc Ile | tac Tyr | aac Asn 405 | gtg Val | tta Leu | cca Pro | acg Thr 410 | act Thr | tcg Ser | tta Leu | gtg Val | tta Leu | gga Gly 415 | aaa Lys | aat Asn | 1424 | | |
| caa Gln | aca Thr | ctc Leu 420 | gcg Ala | aca Thr | att Ile | aaa Lys | gct Ala 425 | aag Lys | gaa Glu | aac Asn | caa Gln | tta Leu 430 | agt Ser | caa Gln | ata Ile | 1472 | | |
| ctt Leu | gca Ala 435 | cct Pro | aat Asn | aat Asn | tat Tyr 440 | tat Tyr | cct Pro | tct Ser | aaa Lys | aac Asn | ttg Leu 445 | gcg Ala | cca Pro | atc Ile | gca Ala | 1520 | | |
| tta Leu 450 | aat Asn | gca Ala | caa Gln | gac Asp | gat Asp 455 | ttc Phe | agt Ser | tct Ser | act Thr | cca Pro 460 | att Ile | aca Thr | atg Met | aat Asn | tac Tyr 465 | 1568 | | |
| aat Asn | caa Gln | ttt Phe | ctt Leu | gag Glu 470 | tta Leu | gaa Glu | aaa Lys | acg Thr 475 | aaa Lys | caa Gln | tta Leu | aga Arg | tta Leu | gat Asp 480 | acg Thr | 1616 | | |
| gat | caa | gta | tat | ggg | aat | ata | gca | aca | tac | aat | ttt | gaa | aat | gga | aga | 1664 | | |

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| Asp | Gln | Val | Tyr | Gly | Asn | Ile | Ala | Thr | Tyr | Asn | Phe | Glu | Asn | Gly | Arg | | |
| | | | 485 | | | | | 490 | | | | | 495 | | | | |
| gtg | agg | gtg | gat | aca | ggc | tcg | aac | tgg | agt | gaa | gtg | tta | ccg | caa | att | 1712 | |
| Val | Arg | Val | Asp | Thr | Gly | Ser | Asn | Trp | Ser | Glu | Val | Leu | Pro | Gln | Ile | | |
| | | 500 | | | | | 505 | | | | | 510 | | | | | |
| caa | gaa | aca | act | gca | cgt | atc | att | ttt | aat | gga | aaa | gat | tta | aat | ctg | 1760 | |
| Gln | Glu | Thr | Thr | Ala | Arg | Ile | Ile | Phe | Asn | Gly | Lys | Asp | Leu | Asn | Leu | | |
| | 515 | | | | | 520 | | | | 525 | | | | | | | |
| gta | gaa | agg | cgg | ata | gcg | gcg | gtt | aat | cct | agt | gat | cca | tta | gaa | acg | 1808 | |
| Val | Glu | Arg | Arg | Ile | Ala | Ala | Val | Asn | Pro | Ser | Asp | Pro | Leu | Glu | Thr | | |
| 530 | | | | | 535 | | | | 540 | | | | | | 545 | | |
| act | aaa | ccg | gat | atg | aca | tta | aaa | gaa | gcc | ctt | aaa | ata | gca | ttt | gga | 1856 | |
| Thr | Lys | Pro | Asp | Met | Thr | Leu | Lys | Glu | Ala | Leu | Lys | Ile | Ala | Phe | Gly | | |
| | | | 550 | | | | | | 555 | | | | | 560 | | | |
| ttt | aac | gaa | ccg | aat | gga | aac | tta | caa | tat | caa | ggg | aaa | gac | ata | acc | 1904 | |
| Phe | Asn | Glu | Pro | Asn | Gly | Asn | Leu | Gln | Tyr | Gln | Gly | Lys | Asp | Ile | Thr | | |
| | | 565 | | | | | 570 | | | | | | 575 | | | | |
| gaa | ttt | gat | ttt | aat | ttc | gat | caa | caa | aca | tct | caa | aat | atc | aag | aat | 1952 | |
| Glu | Phe | Asp | Phe | Asn | Phe | Asp | Gln | Gln | Thr | Ser | Gln | Asn | Ile | Lys | Asn | | |
| | | 580 | | | | | 585 | | | | | 590 | | | | | |
| cag | tta | gcg | gaa | tta | aac | gca | act | aac | ata | tat | act | gta | tta | gat | aaa | 2000 | |
| Gln | Leu | Ala | Glu | Leu | Asn | Ala | Thr | Asn | Ile | Tyr | Thr | Val | Leu | Asp | Lys | | |
| | 595 | | | | | 600 | | | | | 605 | | | | | | |
| atc | aaa | tta | aat | gca | aaa | atg | aat | att | tta | ata | aga | gat | aaa | cgt | ttt | 2048 | |
| Ile | Lys | Leu | Asn | Ala | Lys | Met | Asn | Ile | Leu | Ile | Arg | Asp | Lys | Arg | Phe | | |
| 610 | | | | | 615 | | | | 620 | | | | | | 625 | | |
| cat | tat | gat | aga | aat | aac | ata | gca | gtt | ggg | gcg | gat | gag | tca | gta | gtt | 2096 | |
| His | Tyr | Asp | Arg | Asn | Asn | Ile | Ala | Val | Gly | Ala | Asp | Glu | Ser | Val | Val | | |
| | | | | 630 | | | | | 635 | | | | | 640 | | | |
| aag | gag | gct | cat | aga | gaa | gta | att | aat | tcg | tca | aca | gag | gga | tta | ttg | 2144 | |
| Lys | Glu | Ala | His | Arg | Glu | Val | Ile | Asn | Ser | Ser | Thr | Glu | Gly | Leu | Leu | | |
| | | 645 | | | | | | 650 | | | | | 655 | | | | |
| tta | aat | att | gat | aag | gat | ata | aga | aaa | ata | tta | tca | ggt | tat | att | gta | 2192 | |
| Leu | Asn | Ile | Asp | Lys | Asp | Ile | Arg | Lys | Ile | Leu | Ser | Gly | Tyr | Ile | Val | | |
| | | 660 | | | | | 665 | | | | | 670 | | | | | |
| gaa | att | gaa | gat | act | gaa | ggg | ctt | aaa | gaa | gtt | ata | aat | gac | aga | tat | 2240 | |
| Glu | Ile | Glu | Asp | Thr | Glu | Gly | Leu | Lys | Glu | Val | Ile | Asn | Asp | Arg | Tyr | | |
| | 675 | | | | | 680 | | | | | 685 | | | | | | |
| gat | atg | ttg | aat | att | tct | agt | tta | cgg | caa | gat | gga | aaa | aca | ttt | ata | 2288 | |
| Asp | Met | Leu | Asn | Ile | Ser | Ser | Leu | Arg | Gln | Asp | Gly | Lys | Thr | Phe | Ile | | |
| 690 | | | | | 695 | | | | 700 | | | | | | 705 | | |
| gat | ttt | aaa | aaa | tat | aat | gat | aaa | tta | ccg | tta | tat | ata | agt | aat | ccc | 2336 | |
| Asp | Phe | Lys | Lys | Tyr | Asn | Asp | Lys | Leu | Pro | Leu | Tyr | Ile | Ser | Asn | Pro | | |
| | | | | 710 | | | | | 715 | | | | | | 720 | | |

aat tat aag gta aat gta tat gct gtt act aaa gaa aac act att att 2384
 Asn Tyr Lys Val Asn Val Tyr Ala Val Thr Lys Glu Asn Thr Ile Ile
 725 730 735

aat cct agt gag aat ggg gat act agt acc aac ggg atc aag aaa att 2432
 Asn Pro Ser Glu Asn Gly Asp Thr Ser Thr Asn Gly Ile Lys Lys Ile
 740 745 750

tta atc ttt tct aaa aaa ggc tat gag ata gga taaggtaatt ctaggtgatt 2485
 Leu Ile Phe Ser Lys Lys Gly Tyr Glu Ile Gly
 755 760

tttaaattat ctaaaaaaca gtaaaattaa aacatactct ttttgtaaga aatacaagga 2545
 gagtatgttt taaacagtaa tctaaatcat cataatcctt tgagattgtt tgtaggatcc 2605

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<211> 764

<212> PRT

<213> Bacillus anthracis

<400> 4

Met Lys Lys Arg Lys Val Leu Ile Pro Leu Met Ala Leu Ser Thr Ile
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 20 25 30
 Gln Glu Asn Arg Leu Leu Asn Glu Ser Glu Ser Ser Ser Gln Gly Leu
 35 40 45
 Leu Gly Tyr Tyr Phe Ser Asp Leu Asn Phe Gln Ala Pro Met Val Val
 50 55 60
 Thr Ser Ser Thr Thr Gly Asp Leu Ser Ile Pro Ser Ser Glu Leu Glu
 65 70 75 80
 Asn Ile Pro Ser Glu Asn Gln Tyr Phe Gln Ser Ala Ile Trp Ser Gly
 85 90 95
 Phe Ile Lys Val Lys Lys Ser Asp Glu Tyr Thr Phe Ala Thr Ser Ala
 100 105 110
 Asp Asn His Val Thr Met Trp Val Asp Asp Gln Glu Val Ile Asn Lys
 115 120 125
 Ala Ser Asn Ser Asn Lys Ile Arg Leu Glu Lys Gly Arg Leu Tyr Gln
 130 135 140
 Ile Lys Ile Gln Tyr Gln Arg Glu Asn Pro Thr Glu Lys Gly Leu Asp
 145 150 155 160
 Phe Lys Leu Tyr Trp Thr Asp Ser Gln Asn Lys Lys Glu Val Ile Ser
 165 170 175
 Ser Asp Asn Leu Gln Leu Pro Glu Leu Lys Gln Lys Ser Ser Asn Ser
 180 185 190
 Arg Lys Lys Arg Ser Thr Ser Ala Gly Pro Thr Val Pro Asp Arg Asp
 195 200 205
 Asn Asp Gly Ile Pro Asp Ser Leu Glu Val Glu Gly Tyr Thr Val Asp
 210 215 220
 Val Lys Asn Lys Arg Thr Phe Leu Ser Pro Trp Ile Ser Asn Ile His
 225 230 235 240
 Glu Lys Lys Gly Leu Thr Lys Tyr Lys Ser Ser Pro Glu Lys Trp Ser
 245 250 255
 Thr Ala Ser Asp Pro Tyr Ser Asp Phe Glu Lys Val Thr Gly Arg Ile
 260 265 270
 Asp Lys Asn Val Ser Pro Glu Ala Arg His Pro Leu Val Ala Ala Tyr
 275 280 285
 Pro Ile Val His Val Asp Met Glu Asn Ile Ile Leu Ser Lys Asn Glu

| | | |
|---|-----|-----|
| 290 | 295 | 300 |
| Asp Gln Ser Thr Gln Asn Thr Asp Ser Glu Thr Arg Thr Ile Ser Lys | | |
| 305 | 310 | 315 |
| Asn Thr Ser Thr Ser Arg Thr His Thr Ser Glu Val His Gly Asn Ala | | 320 |
| | 325 | 330 |
| | | 335 |
| Glu Val His Ala Ser Phe Phe Asp Ile Gly Gly Ser Val Ser Ala Gly | | |
| | 340 | 345 |
| | | 350 |
| Phe Ser Asn Ser Asn Ser Ser Thr Val Ala Ile Asp His Ser Leu Ser | | |
| | 355 | 360 |
| | | 365 |
| Leu Ala Gly Glu Arg Thr Trp Ala Glu Thr Met Gly Leu Asn Thr Ala | | |
| | 370 | 375 |
| | | 380 |
| Asp Thr Ala Arg Leu Asn Ala Asn Ile Arg Tyr Val Asn Thr Gly Thr | | |
| 385 | 390 | 395 |
| | | 400 |
| Ala Pro Ile Tyr Asn Val Leu Pro Thr Thr Ser Leu Val Leu Gly Lys | | |
| | 405 | 410 |
| | | 415 |
| Asn Gln Thr Leu Ala Thr Ile Lys Ala Lys Glu Asn Gln Leu Ser Gln | | |
| | 420 | 425 |
| | | 430 |
| Ile Leu Ala Pro Asn Asn Tyr Tyr Pro Ser Lys Asn Leu Ala Pro Ile | | |
| | 435 | 440 |
| | | 445 |
| Ala Leu Asn Ala Gln Asp Asp Phe Ser Ser Thr Pro Ile Thr Met Asn | | |
| | 450 | 455 |
| | | 460 |
| Tyr Asn Gln Phe Leu Glu Leu Glu Lys Thr Lys Gln Leu Arg Leu Asp | | |
| 465 | 470 | 475 |
| | | 480 |
| Thr Asp Gln Val Tyr Gly Asn Ile Ala Thr Tyr Asn Phe Glu Asn Gly | | |
| | 485 | 490 |
| | | 495 |
| Arg Val Arg Val Asp Thr Gly Ser Asn Trp Ser Glu Val Leu Pro Gln | | |
| | 500 | 505 |
| | | 510 |
| Ile Gln Glu Thr Thr Ala Arg Ile Ile Phe Asn Gly Lys Asp Leu Asn | | |
| | 515 | 520 |
| | | 525 |
| Leu Val Glu Arg Arg Ile Ala Ala Val Asn Pro Ser Asp Pro Leu Glu | | |
| | 530 | 535 |
| | | 540 |
| Thr Thr Lys Pro Asp Met Thr Leu Lys Glu Ala Leu Lys Ile Ala Phe | | |
| 545 | 550 | 555 |
| | | 560 |
| Gly Phe Asn Glu Pro Asn Gly Asn Leu Gln Tyr Gln Gly Lys Asp Ile | | |
| | 565 | 570 |
| | | 575 |
| Thr Glu Phe Asp Phe Asn Phe Asp Gln Thr Ser Gln Asn Ile Lys | | |
| | 580 | 585 |
| | | 590 |
| Asn Gln Leu Ala Glu Leu Asn Ala Thr Asn Ile Tyr Thr Val Leu Asp | | |
| | 595 | 600 |
| | | 605 |
| Lys Ile Lys Leu Asn Ala Lys Met Asn Ile Leu Ile Arg Asp Lys Arg | | |
| | 610 | 615 |
| | | 620 |
| Phe His Tyr Asp Arg Asn Asn Ile Ala Val Gly Ala Asp Glu Ser Val | | |
| 625 | 630 | 635 |
| | | 640 |
| Val Lys Glu Ala His Arg Glu Val Ile Asn Ser Ser Thr Glu Gly Leu | | |
| | 645 | 650 |
| | | 655 |
| Leu Leu Asn Ile Asp Lys Asp Ile Arg Lys Ile Leu Ser Gly Tyr Ile | | |
| | 660 | 665 |
| | | 670 |
| Val Glu Ile Glu Asp Thr Glu Gly Leu Lys Glu Val Ile Asn Asp Arg | | |
| | 675 | 680 |
| | | 685 |
| Tyr Asp Met Leu Asn Ile Ser Ser Leu Arg Gln Asp Gly Lys Thr Phe | | |
| | 690 | 695 |
| | | 700 |
| Ile Asp Phe Lys Lys Tyr Asn Asp Lys Leu Pro Leu Tyr Ile Ser Asn | | |
| 705 | 710 | 715 |
| | | 720 |
| Pro Asn Tyr Lys Val Asn Val Tyr Ala Val Thr Lys Glu Asn Thr Ile | | |
| | 725 | 730 |
| | | 735 |
| Ile Asn Pro Ser Glu Asn Gly Asp Thr Ser Thr Asn Gly Ile Lys Lys | | |
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 <212> DNA
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<220>
 <223> forward PCR primer

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<220>
 <223> reverse PCR primer

<400> 6
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<210> 7
 <211> 66
 <212> DNA
 <213> Homo sapiens

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 tcggct 66

<210> 8
 <211> 22
 <212> PRT
 <213> Homo sapiens

<400> 8
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 Ala Val Phe Val Ser Ala
 20